Solutions Manual

Materials Engineering - Bonding, Structure, and Structure-Property Relationships
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Chapter 2

(2) **Write the electron configurations for:**

(a) **Li** $1s^2 2s^1$

(b) **Li^{1+}** $1s^2$

(c) **Fe^{2+}** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$

(d) **Cu^{1+}** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$

(3) **What is the common oxidation state of calcium? Justify this on the basis of the filling of the electron orbitals.**

The common oxidation of Ca is 2+. This can be justified by looking at its electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$. Calcium can reach a full electron shell [Ar] by losing its two 4s valence electrons and leaving it with an electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6$.

(4) **What would you expect the chemical formula of a compound of magnesium and sulfur to be?**

Since the most common oxidation states are Mg^{2+} and S^{2-}, the chemical formula would be MgS

(5) **Elemental analysis is performed on a sample of sodium silicate, and the Na:Si ratio is found to be 2:1. What is the chemical formula of the compound?**

Taking the simplest case where there are 2 sodium ions and 1 silicon ion, this gives a total of 6 positive charges (2 Na^+ and 1 Si^{4+}). Silicates are oxide materials thus the anion will be O^{2-}. In order to maintain charge neutrality Na_2SiO_3 is the resulting compound.

(6) **Suppose you have an ionic compound made up of silicon and fluorine. On the basis of your knowledge of common oxidation states, write the chemical formula of the compound.**

The common oxidation states of silicon and fluorine are Si^{4+} and F^- respectively. In order to maintain charge neutrality, 4 fluorine ions are necessary for every silicon ion. A resulting chemical formula would be SiF_4.

(7) **What is the molecular weight of kaolinite ($Al_2Si_2O_5(OH)_4$)? Show your work**.

Al: 26.981539 g/mole
Si: 28.0855 g/mole

O: 15.9994 g/mole
H: 1.00794 g/mole

Molecular weight = 2(26.981539) + 2(28.0855) + 9(15.9994) + 4(1.00794) = 258.16g/mole

(8) **What are the charges on each of the ions in apatite: $Ca_5(PO_4)_3OH$?**

Ca: 2+
P: 5+
O: 2–
H: 1+